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PIPELINE PIG

This invention generally relates to mechanical pigging devices, commonly referred to simply as "pigs", for use in pipelines or other tubulars. Such pigs are known to find utility in a diverse range of applications, including for cleaning purposes and for conveying equipment in the case, for example, of pipeline monitoring. In the present invention there is described a unique pig suitable for use in the cleaning of internal surfaces of a pipeline or tubular and, in a variation thereof, suitable for applying coatings or other fluids to the aforesaid surfaces.

It is known in the art to cause cleaning pigs to be propelled through a pipe or tubing under the influence of a pressurised fluid. Pigs, designed for this purpose, typically have a flexible cylindrical body made, for example, from a polyurethane foam. Other materials have also commonly been used, including rubber, metal, plastics and combinations and composites. The rear and front end walls of the cylindrical body may be covered with an impervious coating designed to form a moving seal with the inner wall of the pipe. With this design, the pig essentially acts as a piston as it is conveyed through the pipeline or tubular; the fluid on its rear side having a higher pressure head than the fluid at its front side.

Notably, pigs propelled through pipelines or the like in the manner described above are intended to prevent propelling fluid from flowing through or around the pig. Implicated by this, pigs used for cleaning purposes have, in the past, been intended to physically push and

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1 forceout debris in advance of the pig as it travels  
2 through the pipe bore. At best, the pig itself provides  
3 an additional wiping function on the pipe walls.

5 In the present invention it is recognised that, on  
6 occasion, it would be advantageous to provide a more  
7 rigorous cleaning process to a pipeline bore than merely  
8 pushing loose debris and wiping the surfaces. In the  
9 art, those who have addressed this problem have  
10 contemplated the provision of scratching elements, such  
11 as wire bristles, on the circumferential walls of the  
12 pig. While related designs provide for a more aggressive  
13 cleaning process, such pigs usually do not allow for  
14 sufficient fluid flow past the bristles to allow for the  
15 bristles themselves to be cleaned. In use, debris,  
16 shavings, slivers and the like can become lodged between  
17 the bristles, serving to reduce the efficiency of the  
18 pig's travel and the cleaning process.

20 An object of the present invention is to obviate or at  
21 least mitigate these and other disadvantages associated  
22 with pipeline or tubular cleaning pigs. In one aspect,  
23 the invention seeks to achieve this by creating an  
24 alternative means for the propulsion of the pig through  
25 the pipeline or other tubular.

27 A further object of the invention herein is to employ the  
28 novel propulsion features disclosed herein in relation to  
29 pigs for use in respect of other functions, including  
30 pigs intended to act as mechanical applicators.

32 According to a first aspect of the present invention  
33 there is provided a pig for use in a tubular bore,  
34 wherein the pig is provided with one or more blades



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1 According to a second aspect of the present invention  
2 there is provided a pig for use in a tubular, wherein the  
3 pig is comprised of a stabiliser body wherein the  
4 stabiliser body supports a plurality of blades and is  
5 conveyed mechanically through a tubular.

6

7 Preferably the pig is a cleaning pig wherein the blades  
8 of the pig are designed to scrape the internal surfaces  
9 of the tubular bore whilst the stabiliser body provides  
10 centralisation.

11

12 Preferably the blades may be adapted so that they do not  
13 exhibit any abrasive qualities thereby reducing the risk  
14 of damage if the pig is to be used in tubing which is  
15 plastic coated.

16

17 Preferably the blade properties can be pre selected to be  
18 adapted to flex through a profiled restriction in the  
19 tubular bore thereby providing a means of confirming the  
20 position of a pig within the tubulars.

21 According to a third aspect of the present invention  
22 there is provided a pig for use in a tubular, wherein the  
23 pig is adapted to rotate in its longitudinal axis under  
24 the influence of a propulsion fluid as it is displaced  
25 through the tubular.

26

27 The pig may be further adapted to rotate in orbit within  
28 the tubular bore.

29

30 According to a fourth aspect of the present invention  
31 there is provided a pig for use in a tubular, the pig  
32 comprising reaction surfaces adapted for forward  
33 propulsion of the pig under the influence of a positive  
34 pressure applied by propulsion fluid travelling through

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1 the tubular, characterised in that the reaction surfaces  
2 are spaced and orientated so as to provide for a net  
3 positive velocity of the propulsion fluid relative to the  
4 pig in the direction of travel through the tubular.

5

6 The reaction surfaces may be provided on a plurality of  
7 respective blades, such as turbine blades. Preferably,  
8 the blades define a fluid by-pass path, the blades being  
9 separated by void areas which permit the relative flow of  
10 fluid through the pig in a forward direction.

11

12 Preferably the reaction surfaces also encourage the  
13 rotation of the pig around its longitudinal axis when  
14 acted upon by the propulsion fluid.

15

16 According to a fifth aspect of the present invention  
17 there is provided a pig for use in a tubular, wherein the  
18 pig is provided with one or more blades having a profile  
19 that precludes rotation of the pig while travelling  
20 through the tubular.

21

22 The blades are typically of varying diameter, the largest  
23 blade or blades potentially, having a diameter greater  
24 than the internal diameter of the tubular.

25

26 Preferably the largest blade or blades are sufficiently  
27 flexible to allow entry and passage of the pig through  
28 the tubular yet sufficiently robust to carry out and  
29 withstand the rigours of the cleaning process.

30

31 It should be understood that references to tubulars  
32 herein, unless the context otherwise dictates, should be  
33 construed in the broadest possible sense, and interpreted  
34 to encompass any form of tubing, pipe or pipeline.

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2 In order to provide a better understanding of the  
3 invention, example embodiments of a pig incorporating the  
4 invention will now be described with reference to the  
5 accompanying Figures;

6

7 Figure 1 shows, in perspective view, a pig intended for  
8 the cleaning of the internal surfaces of coiled tubing as  
9 the pig is propelled along the tubular by a propulsion  
10 fluid.

11

12 Figure 2 shows, in perspective view, a pig intended to  
13 provide stabilisation and cleaning of the internal  
14 surfaces of tubing as the pig is conveyed mechanically  
15 along a tubular.

16

17 Referring firstly to Figure 1, a pig, generally depicted  
18 at 1, comprises substantially of a body 2 and a plurality  
19 of turbine blades 3. The body 2 is generally elongate  
20 and cylindrical. The pig body 2 is suitably made of a  
21 robust material in view of its need to withstand  
22 substantial impact loads, while also functioning in an  
23 aggressive cleaning manner.

24 The blades 3 are afforded a turbine or impeller like  
25 profile, having reaction surfaces 4 that react to the  
26 influence of a propulsion fluid pumped through the coiled  
27 tubing in which the pig 1 is intended to travel. Typical  
28 of turbine blades, the blades 3 can be provided on the  
29 body 2 such that the reaction surfaces 4 are presented at  
30 an acute angle to the linear direction of the fluid flow,  
31 thereby imparting a reaction torque to the body 2 in  
32 addition to a reaction force in the axial direction. In  
33 consequence, the pig 1, when acted upon by a propulsion  
34 fluid, is caused to travel through the coiled tubing in a

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1 generally axial direction, but to also rotate about its  
2 longitudinal axis while so doing.

3

4 Additionally, the pig 1 moves in a third dynamic path.  
5 The outside diameter of the pig 1 can be sized to have a  
6 degree of clearance within the internal bore of the  
7 tubular. That is to say, the maximum outside diameter of  
8 the pig is less than the internal diameter of the  
9 tubular, allowing for radial displacement of the pig 1  
10 during its travel through the tubing. In fact, it is  
11 recognised in the present invention, that such  
12 dimensioning of the pig 1 relative to the tubing causes  
13 the longitudinal axis of the pig 1 to orbit or rotate  
14 about the substantially parallel longitudinal axis of the  
15 tubing.

16

17 This third dynamic path is associated with a number of  
18 advantages. For instance, where it is intended that the  
19 peripheral edges 5 of the blades 3 contact the internal  
20 surfaces of the tubing, the radial displacement of the  
21 pig 1 as it orbits around the longitudinal axis of the  
22 tubing allows for such contact over a range of tubing  
23 diameters. This means that it is not essential that a  
24 respective pig, incorporating the invention hereto, need  
25 be provided to correspond to each size of coiled tubing  
26 or other tubular.

27

28 In an alternative application a pipeline can be cleaned  
29 using a combination of two pigs. The first pig, having  
30 an outer diameter less than the internal diameter of the  
31 tubular, passes through the pipeline removing major  
32 restrictions. The second pig removes additional debris  
33 and in effect polishes the internal surface of the  
34 pipeline.

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2 A further advantage, which applies also to the other  
3 rotational movement of the pig about its own axis, is  
4 that the relative velocity of the blade edges 5 is  
5 considerably higher relative to the tubing surfaces than  
6 that of a pig merely designed for linear movement. This  
7 is particularly advantageous where the pig is intended  
8 for use as a mechanical cleaning device.

9

10 The cleaning pig 1 is designed to clean the internal bore  
11 of coiled tubing. More particularly, the pig 1 is  
12 adapted to apply a rotational cleaning action suitable  
13 for removing scales and other deposits located on the  
14 internal surfaces of the tubing.

15

16 In one use, the pig may be used to prepare the surface of  
17 a tubular, by removing scale or rust not removed by other  
18 cleaning methods, prior to the application of a coating  
19 fluid or material.

20

21 Secondary cleaning of the coiled tubing is achieved by  
22 the effects of disturbances in the flow of the propulsion  
23 fluid through the voids between the turbine blades 3.

24

25 The interaction of the turbine blades with the propulsion  
26 renders the propulsion fluid flow of a turbulent nature.  
27 It will be appreciated by those skilled in the art that  
28 this enhances the cleaning efficiency of the device.

29

30 Furthermore, the presence of voids between the blades 3  
31 results in the propulsion fluid having a positive  
32 velocity relative to the pig. As a consequence of this  
33 positive velocity the propulsion fluid also removes the  
34 debris created by the cleaning of the coiled tubing. The



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1 removal of this debris has the advantage of preventing  
2 the build up of potential blockages in the coiled tubing.  
3 Moreover, debris is also cleaned from the blades of the  
4 pig itself.

6 In an alternative embodiment the reaction surfaces 4 and  
7 most particularly peripheral edges 5 of the blades 3 are  
8 provided with a material suitable for the application of  
9 a coating of other fluid material.

10  
11 With reference to Figure 2, an alternative embodiment of  
12 the present invention generally depicted at 7 comprises a  
13 stabiliser body 8 which has a plurality of blades 9  
14 mounted in a similar configuration to the embodiment  
15 shown in figure 1. The stabiliser body 8 has coupling  
16 means 10 which allow attachment to mechanical driving  
17 means (not shown) so that the stabiliser body 8 is  
18 propelled through a tubular. Where the tubular is casing  
19 or liner in a well-bore, the mechanical driving means may  
20 be a pipe string, for example. Furthermore the blades 9  
21 are mounted on the stabiliser body 8 in a watermelon  
22 shaped configuration which assists entry into and  
23 retrieval out of profiled restrictions.

25 In this manner the embodiment shown in Figure 2 allows  
26 simultaneous centralisation and cleaning for coiled  
27 tubing.

29 Further modifications and improvements may be  
30 incorporated without departing from the scope of the  
31 invention herein intended.